OPERATING AND SERVICE MANUAL

(HP PART NO. 00461-90002)

MODEL 461A/462A
WIDEBAND AMPLIFIER

SERIALS PREFIXED: 606- (461A)
551- (462A)

Appendix C, Manual Backdating Changes,
adapts manual to Serials Prefixed:
418-, 346- (461A)
421-, 414-, and 347- (462A)

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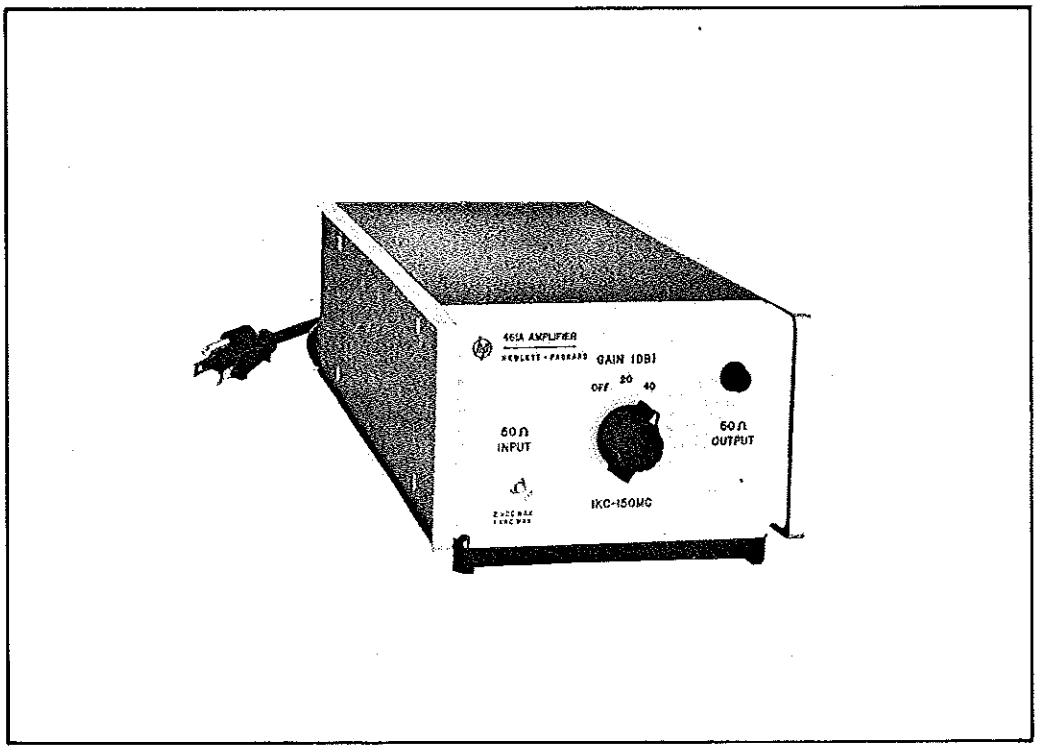
01358-3

Printed: AUG 1966



Model 461A
Wide Band Amplifier

Model 462A
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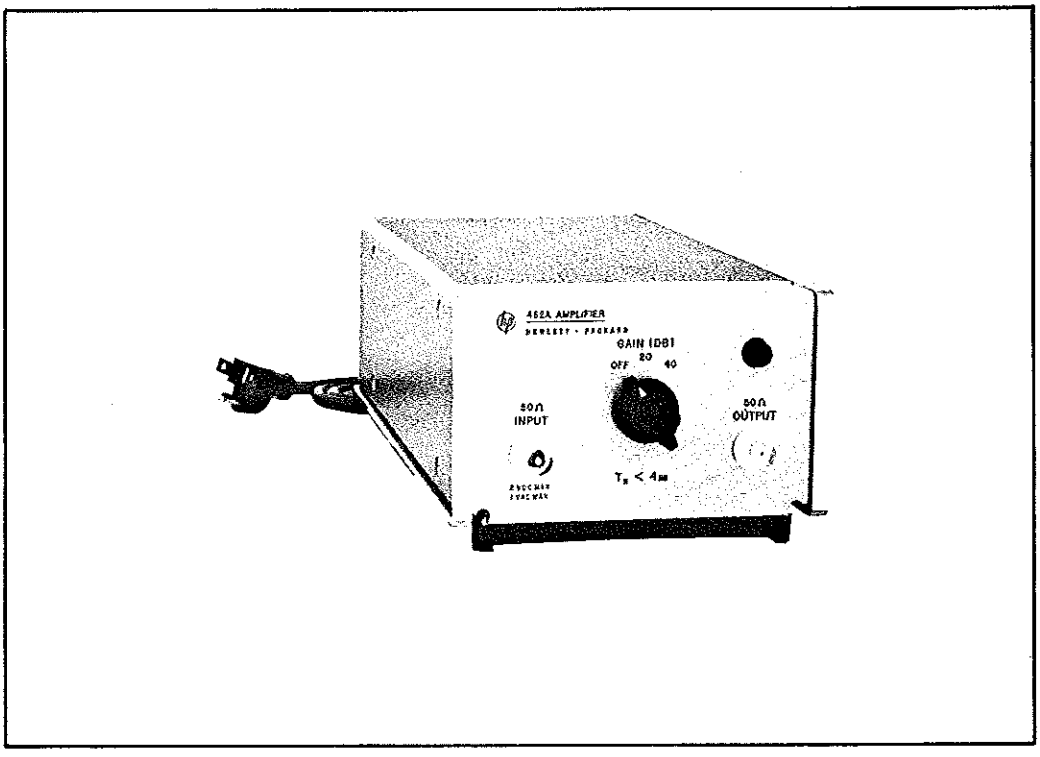


Figure 1-1. Hewlett-Packard Model 461A/462A
Wideband Amplifier

SECTION I
GENERAL INFORMATION

1-1. GENERAL INFORMATION.

1-2. The -hp- Models 461A and 462A Wide Band Amplifiers can faithfully amplify both sinusoidal and complex signals in the 1 KHz to 150 MHz range. The Model 461A is best suited for sinusoidal inputs, and the Model 462A is designed for complex and pulse inputs. The Model 461A frequency response is ±1 db from 1 KHz to 150 MHz. The Model 462A rise and fall times are less than 4 nanoseconds. Either 40 db or 20 db gain can be selected with the front panel GAIN (DB switch. The Models 461A and 462A are shown in Figure 1-1. The specifications of both instruments are given in Table 1-1.

1-3. Since the Models 461A and 462A are nearly identical, this manual will discuss the instruments in terms of the Model 461A. The Model 462A will be mentioned only when its operation differs from that of the Model 461A.

1-4. ACCESSORIES AVAILABLE.

1-5. The -hp- 11048A 50-ohm feedthrough termination is an available accessory that is connected at the output of the Model 461A. The feedthrough termination should be used to ensure that the Model 461A is operating into its rated impedance in the event the instrument is connected to a device with an impedance greater than 50 ohms.

Table 1-1. Specifications

MODEL 461A

Frequency Range: 1 KHz to 150 MHz

Frequency Response: ±1 db, 1 KHz to 150 MHz, when operating into a 50-ohm resistive load (500 KHz reference).

Gain at 500 KHz: 40 db ±0.5 db; or 20 db ±1.0 db, selected by front panel switch. Output is inverted with respect to input.

Output: 0.5 ~~±0.5 volts~~ rms into 50-ohm resistive load.

Distortion: Less than 5% at maximum output and rated load.

MODEL 462A

Pulse Response:
Rise and Fall Time: Less than 4 nanoseconds.

Over and Undershoot: Less than 5%.

Gain: 40 db or 20 db selected by front panel switch. Output is inverted with respect to input.

Pulse Duration for 10% Droop: 30 μsec.

Output: 1 volt peak-to-peak into 50-ohm load.

Delay: Nominally 12-14 nanoseconds.

GENERAL (461A and 462A)

Maximum Input: 1 volt rms or 2 v p-to-p.

Maximum DC Input: ±2 volts.

Overload Recovery: Less than 1 μsec for 10 times overload.

Equivalent Input Noise Level: Less than 40 microvolts in 40 db position.

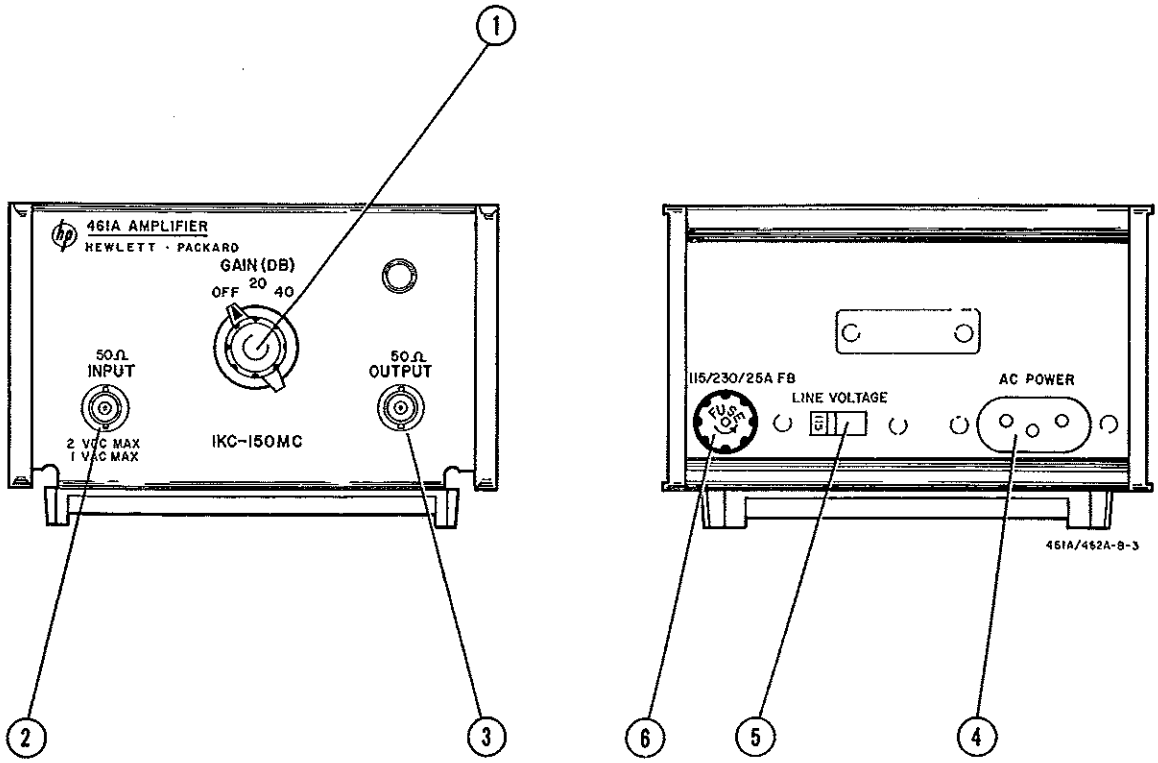
Input Impedance: 50 ohms, nominal.

Power Supply: 115 or 230 v ±10%, 50 to 1000 hertz, 5 watts.

Dimensions: 3-14/32" (8.7 cm) wide x 11" (27.9 cm) long.

Weight: Net: 4 lbs (1.8 Kg). Shipping: 6 lbs (2.7 Kg).

Accessory Furnished: Detachable Power Cord
Accessory Available: -hp- 11048A 50-ohm through termination.



(1) GAIN (DB) switch: Applies primary power and selects gain.

(2) 50 Ω INPUT connector: Connects input signal to the instrument. DO NOT APPLY MORE THAN 1 VAC OR 2 VDC TO INPUT.

(3) 50 Ω OUTPUT connector: Connects amplified output to load. Output must be terminated in 50 Ω. VOLTAGE LEVEL AT OUTPUT MUST NOT EXCEED -6 VOLTS DC OR +0. 6 VOLTS DC.

(4) AC POWER connector: Connects primary power to the instrument.

(5) LINE VOLTAGE: Selects either 115 volts ac or 230 volts ac primary power.

(6) Fuseholder: Contains a 1/4 ampere fast-blow fuse for both 115 and 230 volt operation.

Figure 3-1. Front and Rear Panel Description

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 461A can be used to faithfully amplify signals in the 1 KHz to 150 MHz range. Gain settings of 20 db or 40 db may be selected with the front panel GAIN (DB) switch. The Model 461A will operate within specifications only when its output is terminated in 50 ohms.

3-3. FRONT AND REAR PANEL DESCRIPTION.

3-4. Figure 3-1 describes the function of all the controls and indicators on both the front and rear panel.

3-5. OPERATING INSTRUCTIONS.

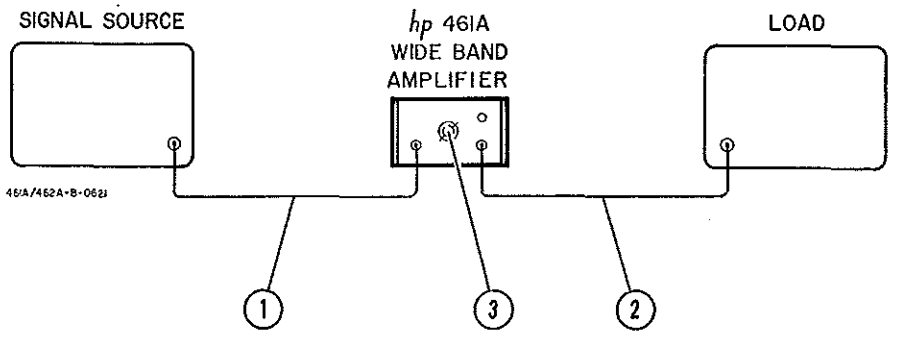
3-6. Figure 3-2 contains the operating instructions for the Model 461A. Each instruction is keyed to a drawing of the front panel.

3-7. IMPEDANCE MATCHING.

3-8. Both the input impedance and the output impedance of the Model 461A are 50 ohms. The Model 461A output must be connected to a 50 Ω load if it is to operate within specifications. If the input impedance of the load is not 50 Ω, a terminating impedance of 50 Ω must be connected across the Model 461A output. The -hp- Model 11048A 50 Ω Feedthrough Termination is recommended for this purpose. The Model 11048A may be easily connected in series with the Model 461A output.

3-9. CASCADING AMPLIFIERS.

3-10. The Model 461A will amplify small signals in the 5 to 50 millivolt range to an amplitude of 0.5 volts with minimum distortion. Should larger output signals be desired, the Model 461A can be cascaded with other amplifiers, such as the -hp- Models 460A and 460B. Typical set-ups cascading the Model 461A and Models 460A and 460B are shown in Figures 3-3 and 3-4.



CAUTION

DO NOT APPLY MORE THAN 1 VAC OR 2 VDC TO INPUT TERMINALS. VOLTAGE LEVEL AT OUTPUT MUST NOT EXCEED -6 VOLTS DC OR +0.6 VOLTS DC.

(1) Connect the 1 KHz to 150 MHz frequency source to the input of the Model 461A.

(2) Connect the output of the Model 461A to a 50-ohm load. The instrument will be within specifications only if connected to a 50-ohm load.

(3) Set Power and Gain Switch to the desired gain setting (20 or 40 db).

NOTE

The maximum output voltage obtainable from the Model 461A is 0.5 volts rms (1 Volt P-P for Model 462A). Thus the maximum input voltage that can be applied, without distortion, is 50 mv on the 20 db range, and 5 mv on the 40 db range.

Figure 3-2. Operating Instructions

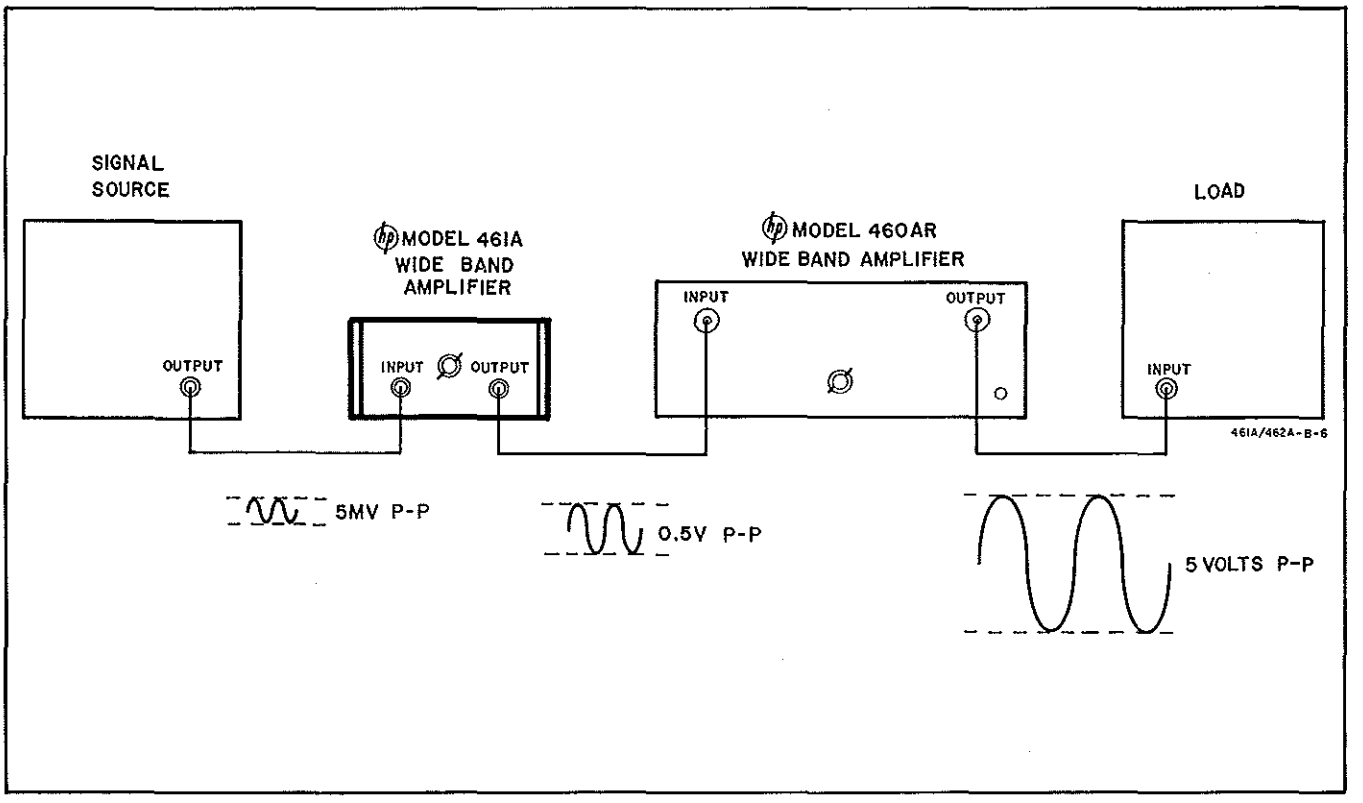


Figure 3-3. Cascading Amplifier

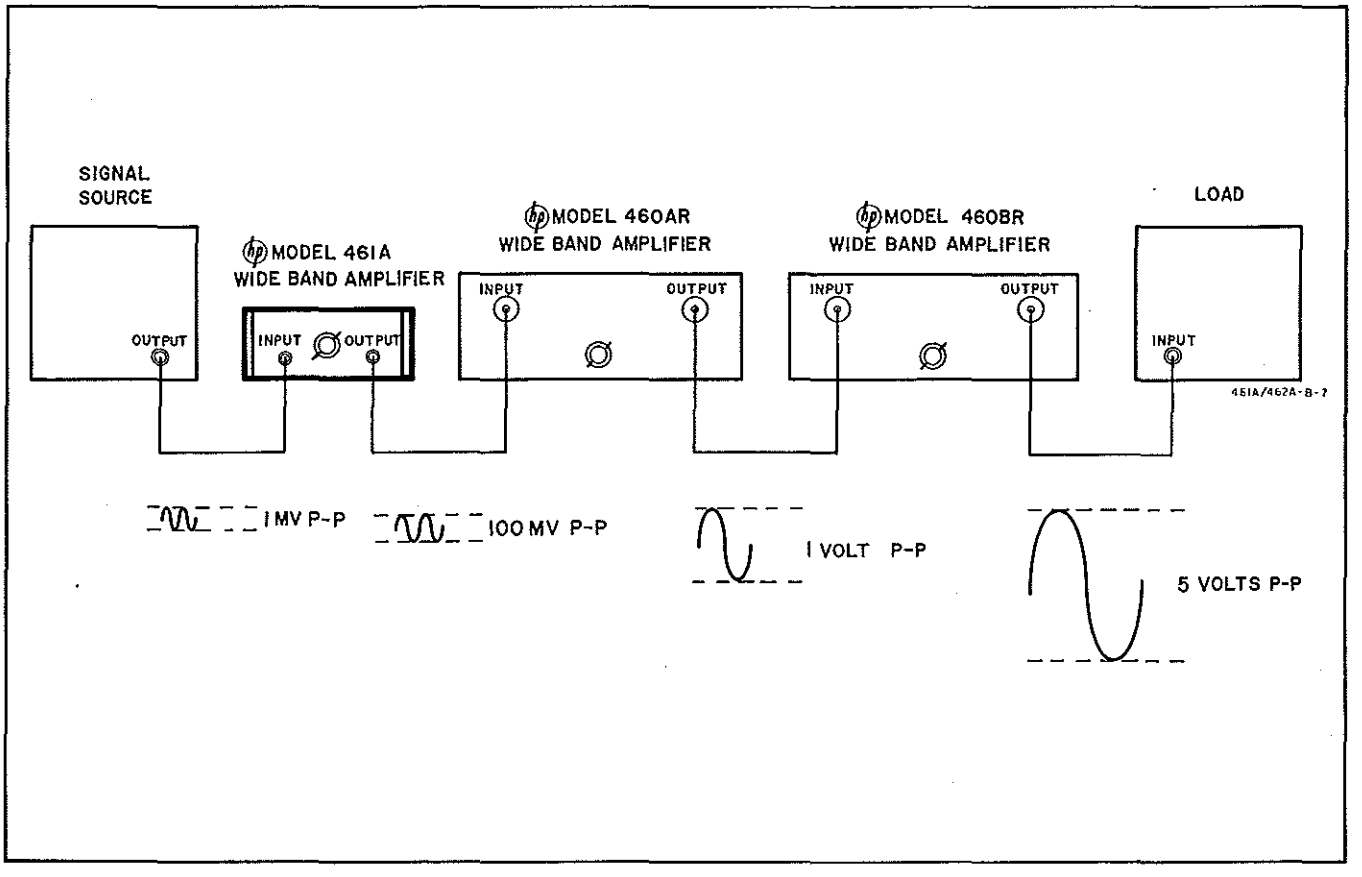


Figure 3-4. Cascading Amplifier

SECTION IV
THEORY OF OPERATION

4-1. GENERAL DESCRIPTION.

4-2. The Models 461A and 462A Amplifiers are essentially identical. In the Model 462A some of the component values are changed slightly to improve its pulse response. In this section both instruments will be presented in terms of the Model 461A.

4-3. Figure 4-1 shows a simplified block diagram of the Model 461A. The amplifier is a five stage, stagger-tuned, cascaded amplifier with emitter follower input and output stages. The gain is switched from 40 db to 20 db by attenuating the input by 20 db. The power supply is a conventional series regulated supply with +15 volt and -15 volt outputs.

4-4. AMPLIFIER CIRCUITS.

4-5. Figure 5-13 shows the schematic diagram of the Model 461A. A3Q3 is the input emitter follower, matching the 50 Ω input impedance to the input impedance of the amplifier. Transistors A3Q4 through A3Q8 constitute a five stage, RC coupled, cascaded amplifier. Each stage has a gain of 8 db, giving the amplifier a total gain of 40 db.

4-6. Each stage has an LR feedback circuit with an adjustable inductor. The feedback circuit in each stage controls the overall gain of the amplifier at a different frequency, so the amplifier must be stagger-tuned. There is some interaction between the stages at certain frequencies. A3Q9 is the output emitter follower, and it matches the amplifier output to a 50 Ω output impedance.

4-7. POWER SUPPLY.

4-8. The power supply generates +15 volts and -15 volts bias supply to the amplifiers. Breakdown diode A2CR3 establishes a 15 volt reference. Control transistor A2Q2 detects differences between the reference voltage and the supply output, and its output controls the series regulator Q1.

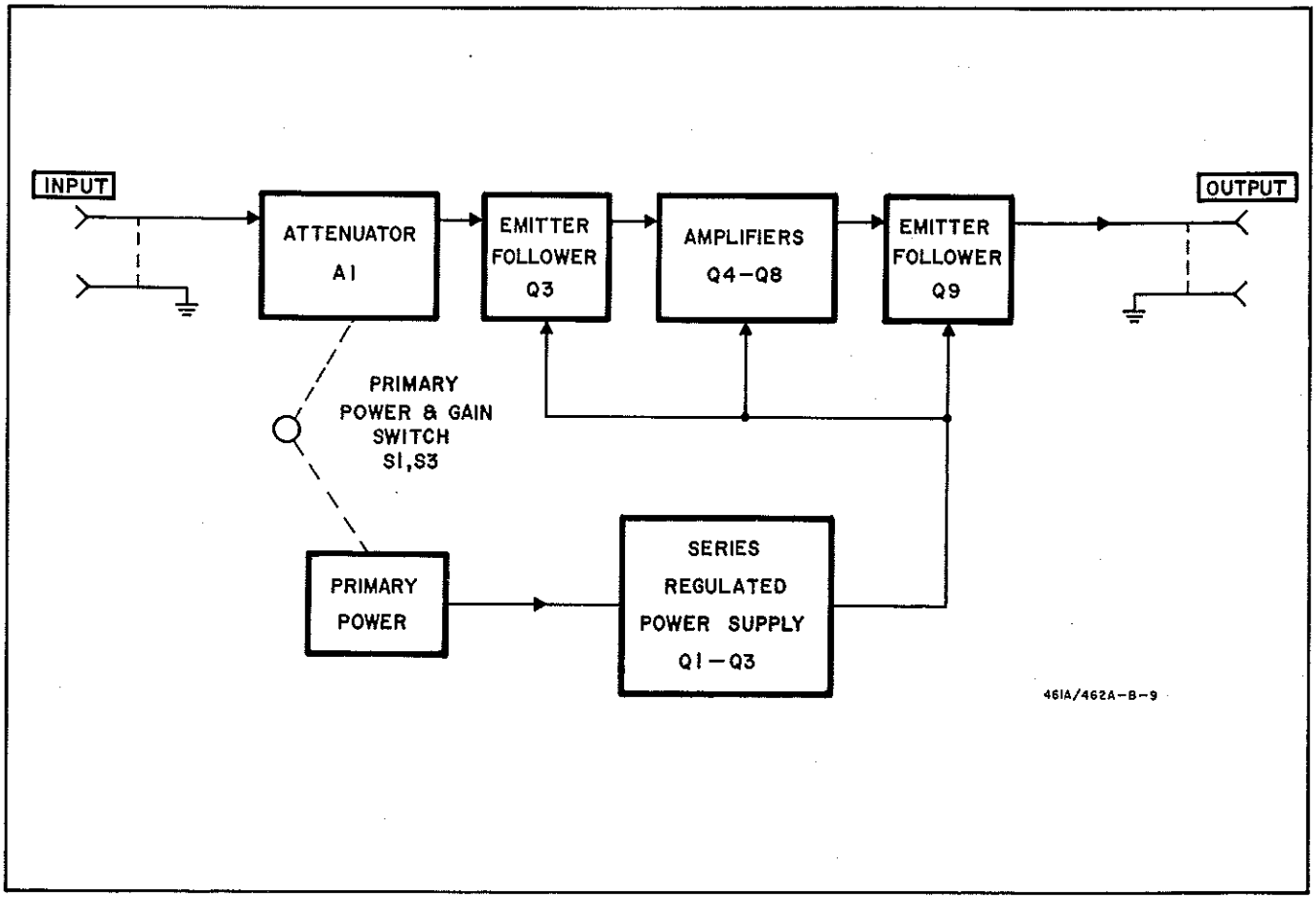


Figure 4-1. Simplified Block Diagram

Table 5-1. Test Equipment Required

Instrument Type	Critical Specifications	Use	Recommended Model
Wide Range Oscillator	Output: 3 v Impedance: 50 ohms Freq. Range: 5 Hz - 500 KHz Distortion: less than 0.5%	Gain Check	-hp- Model 200SR Wide Range Oscillator
Frequency Response Test Set	Freq. Range: 500 KHz to 10 MHz Freq. Response: Flat within +0.5% - 1.5%, 500 KHz to 10 MHz	Frequency Response Check	-hp- Model 739A Frequency Response Test Set
Logarithmic Vacuum Tube Voltmeter	Accuracy: ±1% at full scale Freq. Range: 10 Hz to 500 KHz DB Range: -60 to +10 db	Gain Check	-hp- Model 400L Logarithmic Vacuum Tube Voltmeter
Attenuator	Attenuation: 40 db Accuracy: ±0.1 db Freq. Range: 1 KHz to 150 MHz	Frequency Response and Gain Check	Weinschel 50-40S
Attenuator	Attenuation: 120 db in 10 db steps Freq. Range: 1 KHz to 150 MHz Overall Accuracy: ±1.5 db Impedance: 50 ohms	Frequency Response and Gain Check	-hp- Model 355D VHF Coaxial Attenuator
Distortion Analyzer	Freq. Range: 20 Hz to 500 KHz Sensitivity: Measure 5% distortion Accuracy: ±3%	Distortion Check	-hp- Model 331A Distortion Analyzer
RF Millivoltmeter	Freq. Range: 500 KHz to 150 MHz Accuracy: ±6% full scale DB Range: -30 db to +10 db	Frequency Response Noise Check	-hp- Model 411A RF Millivoltmeter
Multimeter	Accuracy: ±1% full scale Input Resistance: 200 M Ω	Troubleshooting and Power Supply Checks	-hp- Model 412A DC Voltmeter-Ohmmeter-Ammeter
Signal Generator	Freq. Range: 10 MHz - 150 MHz Output: 0.5 v Impedance: 50 ohms	High Frequency Check	-hp- Model 608C/D VHF Signal Generator
Power Meter	Power Range: -30 dbm to +10 dbm Accuracy: ±3% full scale	High Frequency Check	-hp- Model 431A/B Power Meter with -hp- 478A Thermistor Mount
Oscilloscope	Bandwidth: Dc to 200 KHz Sensitivity: 10 mv/cm to 10 v/cm Type: dual trace	Frequency Response Calibration	-hp- Model 122A Dual Track 200 Kc Oscilloscope or -hp- Model 175 Oscilloscope -hp- 1750A and 1780A Plug-in units
Oscilloscope	Bandwidth: 1 KHz to 50 MHz Sensitivity: 0.1 v/cm to 1 v/cm	Pulse Response Check	-hp- Model 175A Oscilloscope
High Frequency Oscilloscope	Bandwidth: 50 MHz to 1 GHz Sensitivity: 200 mv/cm to 5 v/cm	Pulse Response Check and Calibration	-hp- Model 185B 100 Mc Oscilloscope with -hp- 187B Dual Trace Amplifier
Pulse Generator	Impedance: 50 ohms Leading and Trailing Edge: <1 nsec Overshoot and Ringing: <5% peak Corner Rounding Amplitude: <95% of pulse amplitude Pulse Width: 30 nsec	Pulse Response Check and Calibration	-hp- Model 215 Pulse Generator
Pulse Generator	Pulse Width: 1 μsec Pulse Amplitude: 0.5 v, p-p	Pulse Overload Recovery Check	-hp- Model 212A Pulse Generator
Square Wave Generator	Pulse Width: 30 μsec Pulse Amplitude: 0.01 v, p-p	Pulse Decay Check	-hp- Model 211A Square Wave Generator